Distribution and Cycling of Dissolved Organic Carbon and Colored Dissolved Organic Carbon on the West Florida Shelf

Dr. Paula G. Coble
College of Marine Science
University of South Florida
140 7th Ave South
St. Petersburg, FL 33701
Phone: (727) 553-1631 Fax: (727) 553-1189 Email: pcoble@marine.usf.edu

Grant #: N00014-01-1-0041

LONG TERM GOAL

The long term goal of this project is to determine sources, sinks and dynamics of Colored Dissolved Organic Matter (CDOM) and Colored Dissolved Organic Carbon (CDOC) optical properties on spatial and temporal scales relevant to physical/biogeochemical/ optical modeling efforts currently in progress for the West Florida Shelf HYCODE site. Predictive capability is needed for modeling in-water light attenuation and visibility in coastal regions. CDOM is one of the most significant and least understood light attenuating components, hence improved understanding of its optical properties, dynamics and spatial and temporal variability will result in improved radiance models in the littoral zone.

OBJECTIVES

The short term goals are to characterize spatial and temporal variability in optical properties by determining sources and sinks of CDOM and Dissolved Organic Carbon (DOC) for the West Florida Shelf. The loss of CDOM by dilution/physical mixing and photobleaching will also be investigated. Photodegradation rates and effects of sunlight on CDOM optical properties and CDOC/DOC relationship as a function of CDOM source will be determined. This information will be applied to bio-optical and predictive light field models.

APPROACH

We proposed to characterize spatial and temporal variability in optical properties and relative importance of the various sources and sinks of CDOM and DOC)in the ECOHAB (Ecology of Harmful Algal Blooms)/HYCODE study area on the West Florida Shelf (between 27.5° - 26.0°N, 82.25° - 84.5° W, or roughly between Tampa Bay in the north to Charlotte Harbor in the south and 120 miles offshore). Sources studied include phytoplankton (diatoms, dinoflagellates, *Trichdesmium* spp.), rivers (Hillsborough, Manatee, Little Manatee, Alafia, Caloosahatchee and Peace Rivers), and sediments. We will also investigate loss of CDOM by dilution/physical mixing and photobleaching. Photodegradation rates and effects of sunlight on CDOM optical properties and CDOC/DOC relationship as a function of CDOM source will be determined. Analyses will include:

- Detailed surface mapping of CDOM and chlorophyll absorption, fluorescence and DOC concentration using AC-9 and SAFIre.

Report Documentation Page

Form Approved
OMB No. 0704-0188

1. REPORT DATE	2. REPORT TYPE	3. DATES COVERED
30 SEP 2001		**00-00-2001 to 00-00-2001**

4. TITLE AND SUBTITLE	5a. CONTRACT NUMBER
Distribution and Cycling of Dissolved Organic Carbon and Colored Dissolved Organic Carbon on the West Florida Shelf	5b. GRANT NUMBER
	5c. PROGRAM ELEMENT NUMBER
6. AUTHOR(S)	5d. PROJECT NUMBER
	5e. TASK NUMBER
	5f. WORK UNIT NUMBER
7. PERFORMING ORGANIZATION NAME(S) AND ADDRESS(ES) **College of Marine Science,,University of South Florida,140 7th Ave South,,St. Petersburg,,FL, 33701**	8. PERFORMING ORGANIZATION REPORT NUMBER
9. SPONSORING/MONITORING AGENCY NAME(S) AND ADDRESS(ES)	10. SPONSOR/MONITOR'S ACRONYM(S)
	11. SPONSOR/MONITOR'S REPORT NUMBER(S)

12. DISTRIBUTION/AVAILABILITY STATEMENT
Approved for public release; distribution unlimited

13. SUPPLEMENTARY NOTES

14. ABSTRACT

The long term goal of this project is to determine sources, sinks and dynamics of Colored Dissolved Organic Matter (CDOM) and Colored Dissolved Organic Carbon (CDOC) optical properties on spatial and temporal scales relevant to physical/biogeochemical/ optical modeling efforts currently in progress for the West Florida Shelf HYCODE site. Predictive capability is needed for modeling in-water light attenuation and visibility in coastal regions. CDOM is one of the most significant and least understood light attenuating components, hence improved understanding of its optical properties, dynamics and spatial and temporal variability will result in improved radiance models in the littoral zone.

15. SUBJECT TERMS

16. SECURITY CLASSIFICATION OF:			17. LIMITATION OF ABSTRACT	18. NUMBER OF PAGES	19a. NAME OF RESPONSIBLE PERSON
a REPORT	b ABSTRACT	c THIS PAGE			
unclassified	**unclassified**	**unclassified**	**Same as Report (SAR)**	**6**	

- Laboratory incubations of water samples using a solar simulator with subsequent measurement of DOC concentrations and CDOM fluorescence and absorption.

WORK COMPLETED

In the past 12 months, we have participated in the eight field experiments listed in Table 1. EcoHAB (monthly survey cruise) and FSLE4 (biannual aircraft/dispersion cruise) experiments were conducted within the HYCODE study site. Aircraft overflight data for optics experiment validation are available for the FSLE4 cruise. The other three cruises were collaborations among a group of ONR-funded CDOM researchers. The Pelican experiment was conducted in the Mississippi Plume, the Link study site was located between Tampa Bay and Charlotte Harbor, and the Florida Bay experiment was conducted in the waters of south Florida influenced by Florida Bay and the Shark River. Surface mapping and discrete sampling activities took place on board, and samples for photochemistry experiments were returned to the laboratory. Table 1 also shows the status of sample analysis.

Table 1: Participating cruises for October 2000 to September 2001

Cruise	Date of Cruise	Status of fluorescence and absorption samples
EcoHAB	October 2000	stored frozen
FSLE4	November 2000	analysis complete
Pelican	April 2001	analysis complete
Link	April 2001	analysis complete
EcoHAB	June 2001	stored frozen
EcoHAB	July 2001	stored frozen
EcoHAB	August 2001	stored frozen
Florida Bay	September 2001stored frozen	

RESULTS

One of the most unexpected results of our research to date is the marked difference in CDOM fluorescence-salinity relationships for the eastern and western regions of our study area. The freshwater endmember entering the Gulf of Mexico in the Mississippi Plume region has a much lower CDOM fluorescence than does the freshwater source in the HYCODE study area. Figure 1 shows the salinity to CDOM fluorescence relationship for a compilation of cruises in both regions, including some data from before the start of this project. Three cruises in different seasons show remarkable similarity in this relationship for the Mississippi Plume (Pelican, and NEGOM cruises). Other data were collected on the West Florida Shelf between Tampa Bay and the Shark River. The freshwater source in the WFS region is 2 – 6 times higher in CDOM fluorescence as is the Mississippi source.

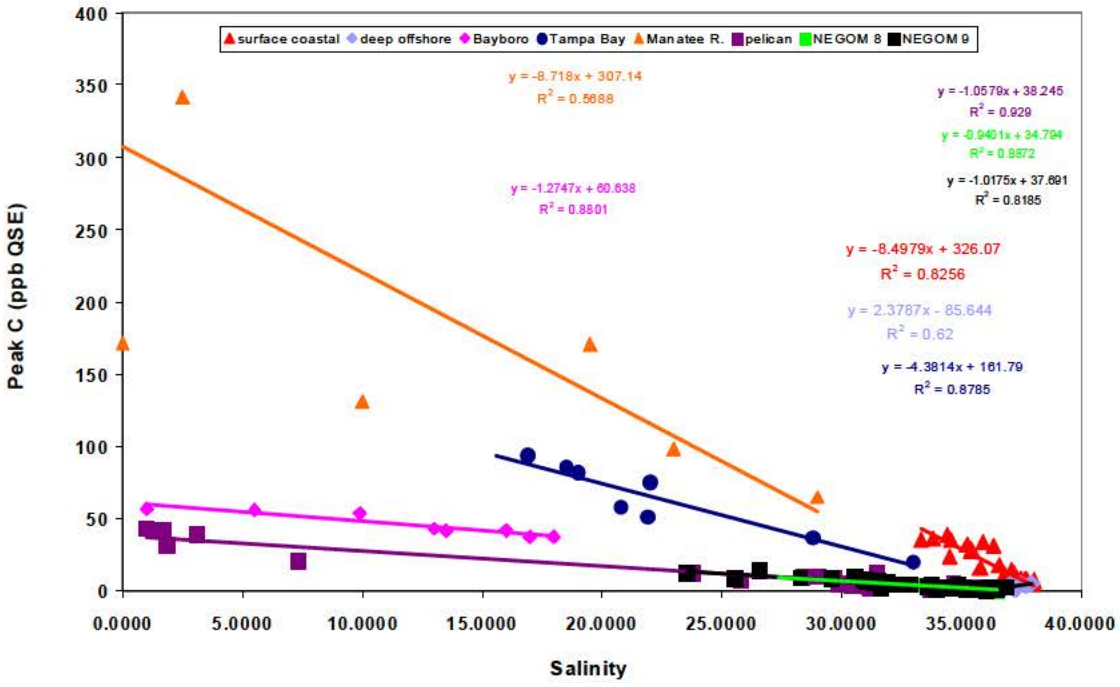

Figure 1. CDOM fluorescence as a function of salinity for various cruises in the Gulf of Mexico.

Unusually low rainfall during 2000 may explain another feature of our data. Results from the FSLE4 cruise, as well as from two earlier cruises show a reversal of the salinity CDOM relationship in bottom water samples. This is well-illustrated in Figure 2 for data collected on the southern WFS during June 2000.

Distinct differences in optical properties have also been observed, both in the two regions and seasonally within each region. Figure 3 shows the relationship between wavelength of maximum CDOM fluorescence emission versus fluorescence intensity for the same data sets. Again, the Mississippi River data differs significantly from freshwater sources in the middle and south WFS regions. Other relationships which may be useful as water source indictors include spectral slope and DOC concentrations. Continuous underway fluorescence data collected using the WetLabs, Inc SAFIre are partially analyzed and will be used to expand spatial coverage of the discrete data.

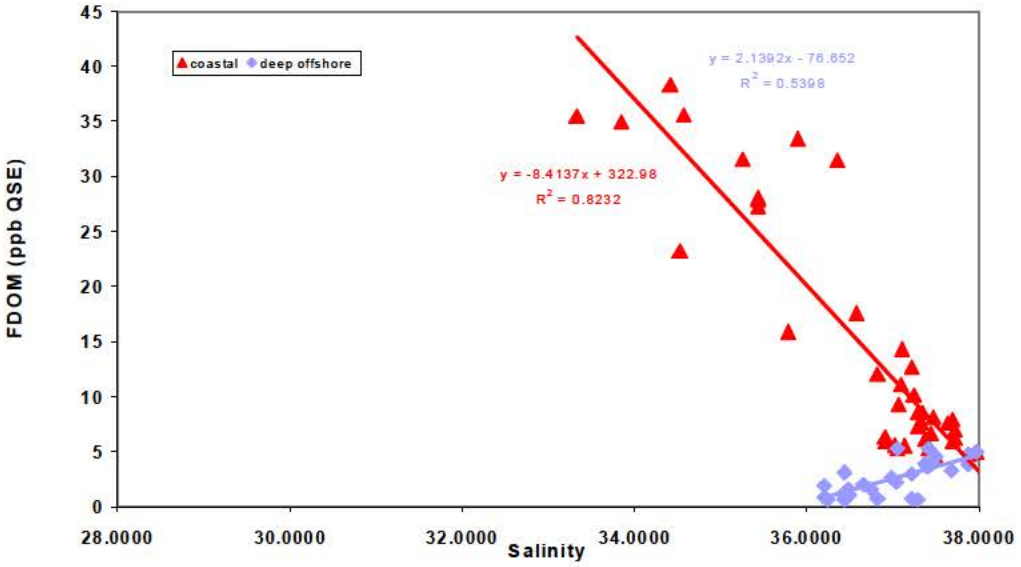

Figure 2. Comparison of CDOM fluorescence as a function of salinity for surface, coastal, and deepwater samples collected in June 2000 in the southern WFS region.

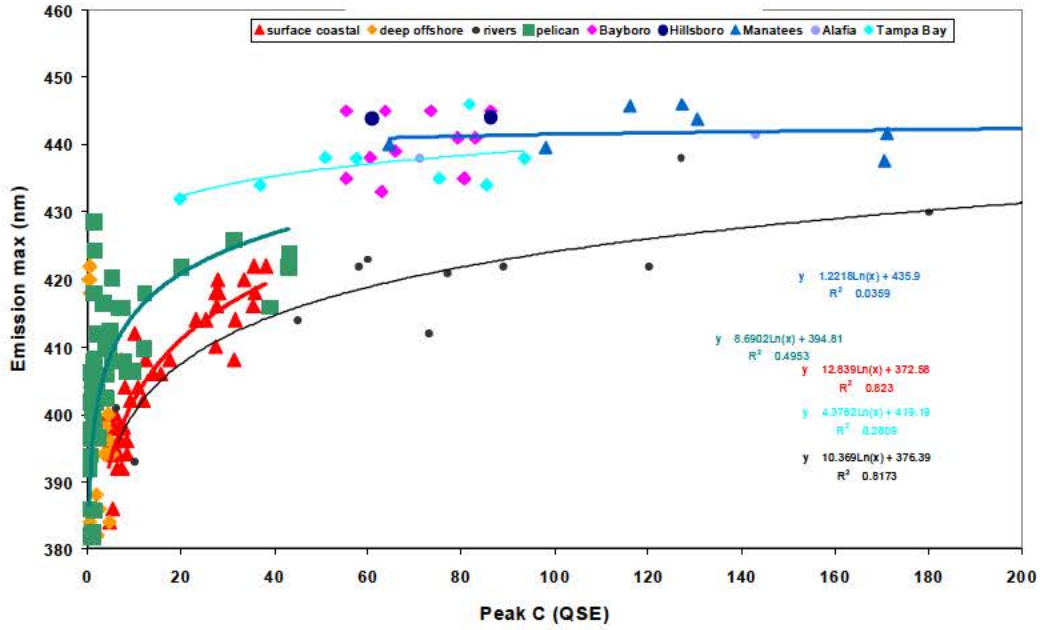

Figure 3. The position of maximum CDOM fluorescence emission wavelength as a function of fluorescence intensity for waters in the Gulf of Mexico.

IMPACT/APPLICATIONS

Data collected from this project will be used to generate detailed surface mapping of CDOM fluorescence and absorption, and DOC concentrations on the West Florida Shelf. Hence, this information will prove useful in improving bio-optical and predictive light field models.

TRANSITIONS

The primary effort during year 2 will be completion of data analysis for samples already in hand, and integration of our results with those of the other HYCODE investigators. We intend to present results of our research at the HYCODE Workshop in January 2002 and also at the Ocean Sciences Meeting in February 2002. Manuscripts will be submitted for publication based on these presentations.

RELATED PROJECTS

In addition, we have been invited to participate in additional cruises to the Florida Bay region through the University of Miami–RSMAS, which we intend to do, as water from this region is thought to have a significant impact on the HYCODE study site. The highly colored water from the Everglades and Florida Bay is thought to move northward along the coast during some conditions, but has never been directly documented in the Tampa Bay area. Provided we can distinguish it optically from local Tampa Bay rivers, we will attempt to develop a set of diagnostic characters of use for hyperspectral remote sensing applications.

PUBLICATIONS

Del Castillo, C.E., P.G. Coble, R.N. Conmy, F.E. Muller-Karger, L. Vanderbloomen, and G.A. Vargo. 2001. Multispectral In-situ Measurements of Organic Matter and Chlorophyll Fluorescence in Seawater: Documenting the Intrusion of the Mississippi River Plume in the West Florida Shelf (in press Limnology and Oceanography)